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ABSTRACT

Integrated or flexible manufacturing is a management strategy that integrates training and the organization of people with the modernization of hardware. It would allow Australian manufacturing organizations to produce value-added goods for niche markets and be competitive. Manufacturing organizations that identify and change their production strategies to meet new consumer requirements of cost, quality, choice, and innovation will establish themselves successfully in the market. Mass production techniques are constraining manufacturing organizations from improving their levels of efficiency, quality, flexibility, and innovation. As a result, increasing numbers of manufacturing firms are moving toward an integrated system of manufacturing. A vital component of integrated manufacturing can be found in new technologies that assist organizations in making the transition from the traditional mass production of standardized products toward the production of smaller batches of higher quality products targeted at niche markets. Implementation of flexible manufacturing may cause changes in job design (or redesign), job content, and skill requirements of the work force. Consequences of technological change may include skill twist, upskilling, and deskilling. Industry, government, schools, and education/training providers should be key players in educational planning. Issues include teaching the importance of lifelong learning, expansion or modification of curricula, and upgrading and generalization of skills. (Contains 83 references.) (YLB)

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Training and organising people for flexible manufacturing

JANINE CESNICH

A literature review

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1: Introduction

Flexible Manufacturing

Integrated or flexible manufacturing¹ is a management strategy which integrates training and the organisation of people with the modernisation of hardware. It is a strategy which could provide the key to major improvements in the productivity and international competitiveness of the Australian manufacturing industry.

Integrated manufacturing is not simply a new technology or system. It is a long term strategy for each manufacturing organisation, which includes *reducing complexity* and bringing the whole manufacturing operation, not just production, into a single well co-ordinated whole unit. [Hayton and Harun, 1988]

Hayton and Harun in the first report in this series defined integrated manufacturing as:

A broad term describing a management approach which aims at simultaneously achieving efficiency, quality and flexibility through integrating all aspects of a manufacturing organisation's operations. It involves the integration of,

- *machines*
- *people*
- *people and machines*
- *systems and procedures*

through the application of information technologies and integrated types of work organisations [Hayton and Harun, 1988].

This definition incorporates both the technical and human aspects of integration and emphasises the critical role both factors play in integrated manufacturing. [Corbett in 'Human centred advanced manufacturing systems: From rhetoric to reality' also emphasises these characteristics]. He stated:

To ensure the performance of the advanced manufacturing system, it is crucial to successfully incorporate both the social and organisational aspects of the process with the technical and systems design procedures [Corbett, 1990]

¹ For the purposes of this paper, as in the Hayton and Harun report, *Training for integrated manufacturing: A review of recent literature* (1988), the terms flexible manufacturing and integrated manufacturing may be used interchangeably.

The first report entitled *Training for integrated manufacturing: A review of recent literature* (Hayton and Harun, 1988) included a review of literature on:

- the key elements and main issues associated with integrated manufacturing;
- trends in integrated manufacturing in Australia and overseas; and
- workforce skill requirements for integrated manufacturing.

The report by Hayton and Harun also identified Australia's broad training and re-training needs in this area. Training implications for industry in Australia and TAFE were also discussed.

The second report in the series entitled *Training for integrated manufacturing: Case studies* (Hayton and Loveder 1990) presented case studies of the following manufacturing firms:

- Sigma Air Conditioning (Lidcombe, NSW)
- Bridges Corporation (Wingfield, SA)
- Philips Headquarters (Eindhoven, Netherlands)
- Philips (Cambridge, UK)
- Milford Fabricating Company (Detroit, Michigan, USA)
- Human Centred CIM systems Project (Esprit 1217)

and the following educational institutions:

- Lehigh University CIM Laboratory (Bethlehem, Pennsylvania, USA)
- North Carolina State University (Raleigh, North Carolina, USA)
- Ngee Ann Polytechnic (Singapore)
- Coventry Polytechnic (Coventry, UK)
- German-Singapore Institute (Singapore)
- CIMM Centre (Regency Park, SA, Australia)
- Oakland Community College (Oakland, Michigan, USA)

The second report provided a number of exemplary training and re-training arrangements for integrated manufacturing in Australia and overseas (from initial training to trade and para-professional level). The study also included a discussion of training implications for industry in Australia and providers of vocational education in Australia arising from the adoption of integrated manufacturing.

The emphasis of a flexible or integrated manufacturing strategy is on simplifying the entire manufacturing process and *reducing complexity* within such areas as marketing, production, distribution, sales and design. It is also aimed at *speeding up the total chain of activities* both inside and outside an organisation in the most uncomplicated and suitable manner. [Bolwjin and Kumpe, 1991]

An investment in integrated manufacturing simultaneously affects all parts of the manufacturing operation, at all levels of the organisation.

Source: NIES, c. 1988-89, *Integrated manufacturing: The management challenge.*

Simplifying and speeding up the manufacturing process requires a detailed examination and the implementation of appropriate changes to a number of internal aspects within a manufacturing organisation. Internal aspects which should be addressed include:

- advanced technology
- work organisation/structure
- human resource management
- management/production techniques

There is often an automatic association between integrated manufacturing and advanced forms of technology. While it cannot be disputed that advanced technology is an essential component of integrated manufacturing, other internal aspects, such as those referred to, must also be considered.

Integrated manufacturing involves a totally different organisational structure than that needed for traditional mass production. The organisational structure within an integrated firm is often characterised by,

- the consolidation of departments
 - flatter management structures
 - fewer hierarchical levels
 - the formation of multi-tasked teams
 - the skill broadening of operators
 - less occupational specialisation
 - higher levels of 'generic' skills
- [SA DETAFE, 1992 (c)]

Advanced technology is an important contributor to the above changes as *advanced technology by its very nature tends to favour organisations and technocultures in which multi-task teams and fewer departments predominate.* [SA DETAFE, 1992 (c)]

There are two aspects of 'integration':

1. 'Humanware':

Advanced technology requires integration of people with machines and software through a high degree of skill, motivation adaptability, achieved via training, job design, incentive systems and employee participation.

2. 'Holistic'

Organisation:

Advanced technology requires integration of a firm's component parts using a strategic approach to planning and a more holistic organisational method [SA DETAFE, 1992 (b)].

This study aims to expand on the issues raised by Hayton, Harun and Loveder. The first report was entitled *Training for integrated manufacturing: A review of recent literature* [Hayton and Harun, 1988]. The second report was entitled *Training for integrated manufacturing: Case studies* [Hayton and Loveder, 1990]. The specific focus of this study is on the social or 'human' dimension of integrated manufacturing or flexible manufacturing as it is more commonly referred to in Europe and Japan. [Hayton and Harun, 1988] In recent years, a significant amount of literature has been published, particularly in Europe, stressing the importance for manufacturing industries to invest not only in advanced forms of technology but to also invest in the education and training of the workforce. Education and training are vital components of integration but are, unfortunately, often neglected by management.

Workers and
Integration

As Moskal, in *Supervision (or lack of it)*, discussing the importance of workers rather than just the technological aspects of integrated manufacturing in the United States, stated,

Some companies (General Motors comes to mind) spent billions of dollars during the 1980s on technology, yet, many experts say forgot the people side of the equation. [Moskal, 1990]

It is not the role of this paper to debate the issues of which has the greater role to play in advancing the process of integrated manufacturing in Australia. However, it is becoming obvious that in meeting international competitive challenges, Australian industry will need to enthusiastically embrace not only technological opportunities but also the opportunities that exist to enhance productivity by appropriate human resource development strategies. In order to regain an acceptable position in the global market the Australian manufacturing industry must seriously question the

Manufacturing in Australia

suitability of a number of its current manufacturing strategies and associated philosophies (of which education and training is but one important component).

There are numerous factors which have contributed to Australia's current predicament. To follow are examples of some of the more intrinsic factors which have influenced the development of Australia's manufacturing industry. Firstly, the Australian manufacturing industry has evolved predominantly as a response to domestic needs. This has resulted in the development of an isolated manufacturing industry which has been heavily reliant on traditional modes of production. The Australian manufacturing industry has also been disadvantaged by:

- distance from overseas markets;
- the small population;
- inability to produce on a large scale.

All these factors have prevented the evolution of a truly world competitive manufacturing industry.

As well as internal factors, significant changes have also occurred throughout the world, (as outlined in *Australia can compete: Towards a flexible adaptable society*), which have had a major impact on manufacturing strategies. The most notable include:

- the increasing pace of technological developments
 - increasing competition from developing countries
 - rising incomes in industrialised countries
 - changing world consumption patterns
 - the development from essentially local economies to global economies
 - increasing competition from rapidly growing countries of North Asia (such as the People's Republic of China, Taiwan, Korea and Hong Kong)
 - the expansion of world trade in manufactured goods, particularly of high technology products (compared to trade in commodities)
- [Marsh, 1988]

Dawkins in 'Training for the competitive edge' stated that the shift from wealth generation by natural resources to wealth generation by 'value-added' goods and services, based on advanced technology and practices [Dawkins, c.1991] is having the most significant impact on Australian manufacturing. The exportation of raw materials (without added value) is having a serious impact on the Australian economy. This situation has contributed to greater unemployment levels and a less favourable balance of payments. The production of value-added goods for niche markets could be a profitable path for

Australian manufacturers to take. Training workers to be highly skilled and multi-skilled would be an essential precondition of success in such a venture.

Much of the literature surveyed suggested that the most successful manufacturing organisations throughout the world are those who have kept up with the trends outlined and who have responded to them accordingly. One of the most significant and widespread responses to these trends has been the move away from traditional modes of mass production towards a more flexible integrated way of manufacturing. Integrated or flexible manufacturing offers organisations the potential to achieve high quality, low cost and greater efficiency.

Integrated manufacturing, therefore, is especially pertinent to Australian manufacturing as it would allow organisations to adapt their production processes more flexibly to niche markets. This involves becoming more responsive to market demands and reducing operational costs which would in turn result in substantial economic changes. The implementation of an integrated manufacturing strategy within the Australian manufacturing industry will, however, require an innovative and progressive approach to production.

Throughout the literature on manufacturing in Australia, the following observations keep reappearing:

- the Australian manufacturing industry is not competitive;
- productivity, manufacturing performance and the standard of living needs to be improved;
- Australian industry needs to be more flexible, efficient and innovative;
- Australia needs a highly skilled and flexible workforce.

As a result, substantial changes are now required in a number of the following areas:

- the technology used to manufacture goods
- organisational structures
- management techniques
- worker's skill requirements

The most successful manufacturing countries in the world (i.e. West Germany, Japan and Sweden) have all successfully adopted new technologies, new management techniques and have made commitment to developing human resources. The majority of Australian manufacturing organisations however, have been somewhat more reluctant to introduce or adopt new technologies, management techniques or make a commitment to human resource development.

This is not to say that there does not exist a number of exemplary organisations throughout the country which have successfully implemented advanced technologies/management techniques and have genuinely committed themselves to upgrading the skills of their employees.

In the late 1980s, the Australian Bureau of Statistics conducted a survey into the manufacturing industry's use of new technologies and techniques, (discussed in *People and technology: New management technologies in manufacturing industries*, 1990). 6500 manufacturing organisations were surveyed and amongst the most notable findings were:

- while many businesses have implemented new management techniques, as a percentage of total manufacturing businesses the number is low;
- the proportion of manufacturers who planned to acquire particular technologies in the future was generally low (e.g. only 11% planned to acquire CAD technology within the next five years);
- planned 1988-89 expenditure on the technologies surveyed was low;
- an estimated 35% of manufacturers who had introduced any of the surveyed advanced manufacturing technologies had difficulty getting staff skilled in normal operations and maintenance of equipment associated with technologies.

The most important outcome of this particular survey, as stated by the Senate Standing Committee on Industry, Science and Technology is that the results are a *timely warning to manufacturing industry to lift its performance*. [Senate Standing Committee on Industry, Science and Technology, 1990]

A survey conducted by Touche Ross, within the same period, also revealed that there was a low awareness of new management techniques amongst firms surveyed and that a number of programs that had been implemented had not been effective. The poor relationship between Australian management and the workforce has been identified as the primary contributor to this problem. [Senate Standing Committee on Industry, Science and Technology, 1990]

These findings go some way into providing an insight as to why the Australian manufacturing industry, on the whole, is lagging behind worldclass manufacturers. Australia is not competitive enough nor is it producing a sufficient number of worldclass quality products.

Workforce skills

Australian industry (excluding a few exceptions) has tended to neglect the skills of the workforce. Most organisations have never really developed a human resource strategy. Over the last few years however, there has been an increasing awareness, especially by government and some progressive manufacturing organisations, that *education lies at the heart of productivity and competitiveness*. [Marsh, 1988] An educated workforce is also required to cope successfully with the changes integration brings. In particular, to deal with the new technology, management techniques and organisational changes. Consequently, there has been a substantial commitment made by government to encourage industry to *invest in training*. As stated in the Mayer Report:

Pressures for improved flexibility and efficiency are leading to initiatives for greater national consistency in education and training arrangements. [Mayer Committee, 1992 (a)]

Furthermore, as work becomes more flexibly organised, workers in turn need to be multi-skilled, creative and adaptable. [Mayer Committee, 1992 (a)]

This awareness has led to the development of six key areas of employment-related competencies,

- language and communication
- mathematics
- scientific and technological understanding
- cultural understanding
- problem solving
- personal and interpersonal skills

The above areas will be discussed in further detail in chapter three.

It is also being widely publicised and accepted that *training is the key to having a workforce which is productive, flexible and highly skilled...a workforce which contributes to Australia's competitive edge*. [Dawkins, c. 1991] The literature surveyed tends to support this belief. In fact, it can be concluded from the material reviewed that the education and training of workers within manufacturing industries is one of the most essential components of productivity.

Comparative studies looking at productivity, machinery and skills were conducted by Daly, Hitchens and Wagner, in 1983-84 of the metal industry, and Steedman and Kruger in 1986-87 of the furniture industry, in Britain and Germany. The studies found that in Germany, when advanced machinery and advanced production methods were introduced into an organisation they were put into smooth operation and fully exploited with the help of a thoroughly qualified workforce. The major overall implication of the study was however, that the *lack of technical expertise and training rather than the lack of modern machinery was the major stumbling block in production*. (Daly, Hitchens and Wagner, 1985]

Other major points of interest raised by the study included,

- In Germany, of all the furniture making companies visited - at least 90% of employees working on the shop floor had undergone a three year training course
- In some British firms it was thought that no employees held the corresponding qualifications
- There was a substantial productivity gap in favour of Germany in the order of 50-60% for the furniture industry as a whole
- Productivity increases in Germany and the importance of skills at all levels was apparent [Steedman and Wagner, 1987]

As stated, it is not sufficient to simply introduce new technology and update machinery and associated processes, without updating or considering the skills of the workforce. Failure to address the human aspects of integrated manufacturing may result in poorer levels of efficiency than may be anticipated. It is becoming increasingly apparent that people are a most important component of this strategy. That is, *people play and will continue to play* a crucial role in flexible manufacturing. [Bolwijn and Kumpe, 1991]

In the following chapters, in this monograph, particular attention will be given to:

- the impact of integrated manufacturing on the skill requirements of the workforce;
- the impact of advanced manufacturing technology on work organisation and job design;
- the educational and training needs of the workforce.

Specific examples of changes occurring in these areas, from both Australia and overseas, will be provided in the following sections.

2: The 'evolution' of flexible manufacturing

New market demands

As a result of the appearance of new market demands manufacturing organisations today are *being challenged from all corners of the globe* [Milford, 1990]. This challenge and other associated pressures (as outlined in the introduction) have had a dramatic impact on the way manufacturing firms operate. In particular, due to the increasing complexity and competitive nature of the market place, the ability of manufacturing organisations to adapt promptly in reaction to, or anticipation of, new market demands has become more crucial today than ever before.

In the past, manufacturing strategies were predominantly shaped by two factors, *price and output* [Bolk, Förster and Haywood, 1989]. Today, however, price is just one of the many factors manufacturing organisations must take into account when formulating their competitive strategy.

Mass production techniques allow firms to reduce their production costs through economies of scale and thus respond effectively to relatively straightforward market demands. It does not however, provide manufacturing organisations with the flexibility needed to adapt quickly to ever-changing market demands of the 1990s. As stated by Gupta, mass production lines *are very efficient but have limited flexibility to adapt to changes*. [Gupta, 1989]

The ability to respond to changes occurring within the market and hence be flexible, is becoming increasingly important for manufacturing industries. An examination of trends amongst consumers over the last 50 years or so clearly indicates that consumers throughout the world have become increasingly sophisticated, discerning and educated. In addition, incomes have risen substantially in comparison to the mid 1900s. Such factors have had a marked effect on consumer expectations. The most prevalent consumer demands which have had far reaching consequences for the manufacturing industry as a whole have included consumers demanding:

- a greater range in the choice of products;
 - better quality products;
 - competitive prices; and
 - better value for money.
- [Bolwijn and Kumpe, 1991]

The Japanese, in particular, have played a pivotal role in giving impetus to the trend amongst manufacturing organisations throughout the world towards producing higher quality products. This in turn has influenced consumer demand for both higher quality products and a wider range of products. As stated by Bolwijn and Kumpe, the Japanese conquered the world *not by means of lower prices, but by offering superior quality*. [Bolwijn and Kumpe, 1990] Quality became an important factor. For example, in the 1980s, Honda recognised the importance of producing and marketing a better quality product. A marketing strategy was formulated by the company which emphasised quality and innovativeness of design rather than simply limiting their marketing strategy to the basic feature of 'people transport'. In fact, the entire car industry in Japan transformed itself from the low quality imitator of the 1950s and early 1960s to the world leader in car quality, technology and price competitiveness. [Burrell, 1992 (a)] The emphasis on quality by many Japanese firms has contributed significantly to quality becoming a major competitive factor facing manufacturers throughout the world.

Today's market place is even more complex, as consumers are demanding a greater number of benefits from the products they purchase. Customers in the 1990s are demanding such things as:

- product reliability;
 - service;
 - brand differentiation; and
 - innovative features.
- [SA DETAFE, 1992 (b)]

Other pressures which producer organisations must contend with include *having to respond to shortening product life cycles and increasing customer expectations on reliable delivery dates*. [Gupta, 1989]

In light of changing consumer demands, manufacturing organisations who identify and change their production strategies accordingly (that is, to meet new consumer requirements of cost, quality, choice and innovation), will establish themselves successfully in the market. This point is supported by Bolwijn and Kumpe. They assert that in order for manufacturing organisations to successfully meet such demands as those discussed, they will need to compete simultaneously on the following four fronts:

- efficiency;
- quality;
- flexibility; and
- innovation. [Bolwijn and Kumpe, 1990]

The literature surveyed revealed that innovation is becoming one of the most important criteria for manufacturing organisations competing in the 1990s. It is an increasingly significant component of both competitiveness and the need to achieve a cost advantage in today's marketplace. With respect to Australia however, most of our innovative products are transferred offshore. According to Gould (Chairman, Continental Venture Capital Ltd), this has played a major role in the *dramatic decline in the competitiveness and size of Australia's manufacturing base*. [Anderson, 1991]

There is a distinct belief within the Japanese car industry, that *innovation is the key* to their success. [Burrell, 1992 (b)] The Japanese car industry also illustrates how difficult it is for industries to develop strategies which allow them to successfully compete on all or several of the 'four fronts'. The dilemma facing the Japanese car industry, at present, is *how to be innovative and efficient at the same time*. [Burrell, 1992 (b)] This problem also arises in the Italian textile industry (Prato). In their work *Structure, strategy and public policy: lessons from the Italian textile industry for Australia*, Weiss and Mathews stated that,

By the late '80s, differentiated demand had become a constant and necessary feature of the market. Firms could therefore no longer rely on continuous product differentiation as the main element in their competitive strategy. Local manufacturers need to up-grade the quality of their products, whilst remaining innovative and price-competitive. [Weiss and Mathews, 1991]

The challenges facing international manufacturing organisations must be recognised in this country. Without full comprehension of the difficulties faced by overseas firms, Australia can not expect to compete successfully in the international arena. As it restructures its manufacturing base, the Australian manufacturing industry needs to be aware of the numerous challenges it may encounter.

The four 'performance criteria' as outlined earlier in this chapter, (i.e. efficiency, quality, flexibility and innovation) constitute the basis of Bolwijn and Kumpe's 'phase model', which (they say) illustrates the evolution of *market requirements, performance criteria and ideal types of firms in the period 1960-2000*. [Bolwijn and Kumpe, 1990] Each of the four market requirements identified by Bolwijn and Kumpe have corresponding performance criteria and ideal types of firms. For example, the market requirement of price has the

corresponding performance criterion, efficiency. A company evolving through this phase of the *evolutionary model* is typified by the 'ideal' *efficient firm*.

The market requirement, quality, has the same performance criterion and is characterised by the *quality firm*. The market demand for a more extensive product line has a flexibility performance criterion and an 'ideal' *flexible firm*. Finally, the *innovative firm* phase has an innovative 'performance criterion' to meet the market requirement for uniqueness.

It is important to recognise that according to Bolwijn and Kumpe *very few companies have mastered* all four phases of their model. [Bolwijn and Kumpe, 1990] Most manufacturing companies operating in the 1990s are in different stages of the 'evolutionary model'. Furthermore, while no one organisation has all the characteristics of all the four phases, *broad features of trends can be recognised* within manufacturing organisations throughout the world. [Bolwijn and Kumpe, 1990] An important characteristic of Bolwijn and Kumpe's model is that it clearly demonstrates that the demand for quality is generating a demand for flexibility.

The importance of the four 'performance criteria' is also enhanced by their recurrent appearance throughout the literature surveyed. For example, Pappas (et al) in *The global challenge: Australian manufacturing in the 1990s* (1990) stated that we must constantly improve and upgrade productivity and quality. In the Mayer Report it was stated that there are pressures in Australia for improved flexibility and efficiency. One of the major themes arising out of the Manufacturing Outlook Conference (1990-91) was that the lack of innovation is one of the major disadvantages in Australia's manufacturing sector (although this was not attributed to the lack of talent to do so). Other disadvantages identified at the conference included the lack of penetration of export markets, and the difficulty of attracting finance for processes which cannot guarantee a return in the near future, if at all.

Mass production

The rigid strategy of mass production is not allowing producer organisations to respond readily to the numerous consumer demands which have arisen in the marketplace. In fact, mass production techniques are constraining manufacturing organisations from improving their levels of efficiency, quality, flexibility and innovation. As a result, an increasing number of manufacturing firms, particularly in countries such as Germany, Sweden and Japan, (if they have not already done so), are moving away from the traditional Tayloristic mode of production, characterised by the large scale production of specialised goods, towards an integrated system of manufacturing.

US and European companies are adopting the efficient 'lean production' manufacturing techniques which took Japan to market supremacy in the 1980s. [Burrell, 1992 (a)]

A flexible strategy of manufacturing, as stated by Nemetz in *Human resource planning in flexible manufacturing organisations: Possibilities and concerns*, allows manufacturing organisations to respond quickly to the demands of a volatile market place. [Nemetz, 1990] Fewer firms today are being designed on the basis of required output volume only. [Bolwijn and Kumpe, 1991] The mass production of standardised products is no longer meeting the market demands of the 1990s. Therefore, as stated previously, the limited flexibility of traditional modes of manufacturing are gradually being replaced by the more flexible strategy of integrated manufacturing.

INTEGRATED MANUFACTURING

Integrated manufacturing aims to transform the manufacturing function from a batch process towards a continuous flow operation, starting with customer orders and ending with product delivery. The resulting manufacturing flexibility could provide Australian manufacturers with the competitive advantage needed to succeed in increasingly tough international markets.

Source: NIES, c. 1988-89, Integrated manufacturing: Human resource implications

Producing goods in a flexible and efficient manner is becoming a primary objective for an increasing number of manufacturing organisations throughout the world. This can be attributed to the fact that *a much greater variety of products can be produced at a higher quality through a flexible manufacturing system.* [Nemetz, 1990] The strategy of mass production due to its inflexible nature does not easily allow for the production of a wide variety of different products. Equipment must be constantly adjusted to accommodate product changes. The down-time associated with such changes is costly and detrimental to a company's

New technology

productivity. An integrated and flexible manufacturing strategy which allows an organisation to react quickly to product changes decreases the need for so many adjustments and thus results in productivity increases.

In order to meet the challenges of the 1990s manufacturing organisations must adopt a more integrated strategy of manufacturing. Flexibility, a major requirement of today's competitive strategy, cannot be achieved by relying on the traditional strategy of mass production.

A vital component of integrated manufacturing can be found in new technologies. New or advanced technologies assist organisations in making the transition from the traditional mass production of *standardised products towards the production of smaller batches of higher quality products which are targeted at niche markets*. [Crewe, 1991] This it seems would be the most logical and productive path for the Australian manufacturing industry to take, but unfortunately Australia seems to be lagging behind many OECD countries in this respect.

It has been pointed out in *Enterprise-based bargaining units: A better way of working* that the Australian market is at a disadvantage because it produces on a small scale, for a small market. While technological advances such as CAM are helping to overcome such disadvantages many small plants in Australia are still only relying on second best technology.

Technology may provide Australian manufacturers with the opportunity to produce a greater variety of products *cheaply, accurately and in small volumes*. [Nemetz, 1990] A number of companies in Europe have been reaping the benefits of new technology for some years now. For example, the implementation of new technology contributed to Kodak's ability to place 250 new products on the market between 1986-87. It also contributes to Philips' (Austria) ability to produce a new generation of audio cassette decks every two to three years. [Bolwijn and Kumpe, 1991]

While new technology plays an important part in achieving flexibility, the ability to be flexible also requires significant changes to an organisation's internal structure. As stated by Bolk, *as technology brings different areas of the firm together, it becomes important to ensure that the problems of interdepartmental boundaries are minimised*. [Bolk, Förster and Haywood, 1989] Drawing further from examples provided by Bolwijn and Kumpe, in their paper 'Manufacturing in the

1990s: Productivity, flexibility and innovation', companies such as Olivetti (Crema, Italy), Fiat (Termoli, Italy) GEC Meters (UK) and Philips (Althofen, Austria) have all attempted to become more flexible by reducing complexity in areas such as product design, factory layouts and organisational structure.

There can be numerous organisational differences between firms who have a mass production strategy and those who have implemented an integrated manufacturing strategy. The most distinct organisational differences are provided in the table below:

Mass production	Flexible manufacturing
• Autonomous management departments • Stratified organisational structure • Long lines of communication • Complex and lengthy flow of information • Division of labour	• Flatter hierarchical structure • Flexible production processes • Leaner overall structure • Devolution of decision-making • Frequent interaction between departments • Semi-autonomous work groups

The skill base of the workforce within an integrated organisation can be considerably different to that of an organisation with a mass production strategy. These differences will be dealt with, in detail, in chapter three of this paper.

Flexible manufacturing and its benefits

The benefits gained from implementing a flexible manufacturing strategy are numerous, and can be found extensively throughout the literature surveyed. Hayes and

Jaikumar in 'Manufacturing's crisis: New technologies, obsolete organisations', stated that manufacturers are being forced to:

- *accelerate the rate of new product introduction;*
- *upgrade tolerances and designs; and*
- *eliminate defects.*

A flexible manufacturing strategy can offer organisations the opportunity to respond more successfully to these challenges.

As stated previously, manufacturing organisations who rely on a mass production strategy are forced to compete largely on price. The goods produced by these companies are also relatively standard and of course are produced on mass. In contrast, a more flexible manufacturing strategy allows for:

- product differentiation;
- product customisation;
- the frequent introduction of new products on the market;
- development of new products and services to closely match consumer demands;
- fast response to changes in demand; and
- a shorter and more reliable lead time from order to delivery. [SA DETAFE, 1992 (b)]

Textile industry

An integrated manufacturing strategy is also being widely implemented within specific industries. As stated previously, the textile industry, worldwide, is currently undergoing significant changes. One of the major goals of this industry is to adapt rapidly to changing market trends. As a result, a number of textile producers throughout the world are altering their modes of production. Such organisations are no longer *producing through large production runs of specialised commodities*. Rather, they are producing through *smaller runs of higher quality fabrics woven on looms carrying more flexible, programmable control technology*. [Weiss and Mathews, 1991]

According to Weiss and Matthews the German textile industry has only recently moved away from mass market strategies towards a more flexible production system, in which smaller production units and higher quality are emphasised. Unfortunately, the Australian textile industry still tends to produce on a mass scale, so that economies of scale can be achieved. This has cost the industry significantly as the goal of minimising cost has been pursued *at the expense of quality*. [Weiss and Mathews, 1991]

It is vital for not only the Australian textile industry but for the entire manufacturing industry, to adopt strategies as good as, and preferably better than, those being implemented by their international counterparts. A radical revamp is needed within manufacturing so that we can compete internationally. If we continue to pursue our current path, Australia's inadequate position in the international market will not be improved.

Crewe, writing about the textile industry in the UK in 'New technologies, employment shifts and gender divisions within the textile industry', acknowledged that in order for firms to survive and succeed the,

only route forward is through the specialisation, diversification into niche products and the move into higher quality production and flexibility of response to fluctuating market demands. [Crewe, 1991]

The 'route forward' described by Crewe is especially pertinent for the Australian manufacturing industry. Furthermore, as stated by Dawkins, by the end of the century:

- our enterprises must be innovative;
- our work practices must be dynamic;
- our workforce must be skilled; and
- Australia must be proud of that innovation, dynamism and skill. [Dawkins, c. 1991]

The benefits of introducing integrated manufacturing are so numerous (see table) that the entire Australian manufacturing industry will need to take Crewe's 'route forward' if we are to respond successfully to the challenges outlined by Dawkins.

Nevertheless it is necessary for Australian manufacturing organisations to realise that, as the NIES point out:

Integrated manufacturing is not a 'quick-fix' solution to fundamental problems in a manufacturing operation. Rather, it is a lengthy and complex strategy for a company to achieve a long-term, sustainable competitive advantage. [NIES, c. 1988-89 (b)]

Why should Australian manufacturing organisations consider implementing an integrated manufacturing strategy?

- Improved profit
- Increased responsiveness to product changes
- Increased responsiveness to customer requests
- Management can operate in a proactive manner rather than crisis mode
- Material cost reduction
- Increased machine utilisation
- Reduced inventory
- Reduced scrap and rework
- Reduced lead times
- Decreased delivery time
- Higher employee morale
- Enhanced customer image
- Greater scheduling flexibility

Source: Adapted from the NIES paper, c. 1987, 'Integrated manufacturing: The strategy for long-term profitability'.

The Australian manufacturing industry needs to be revamped in order to become competitive on a world scale. While there is nothing new or revolutionary in this statement it does continue to bring home the urgency and importance of identifying and implementing alternative modes of production, which may give our industry an edge in the global market-place.

If it is implemented on a significant scale and given substantial commitment, an integrated strategy of manufacturing could turn the Australian manufacturing industry around.

The crux of the strategy, however, is that if substantial change is to occur, it cannot be implemented half-heartedly. It requires complete management and worker commitment and an examination of the entire organisational structure. The strategy not only requires an assessment of workplace skills but more importantly involves an assessment of workplace philosophy.

3: Flexible manufacturing and the workforce

The planning process

An integrated manufacturing strategy is often automatically associated with advanced forms of technology. While new technology does play an integral role in such a strategy, its implementation should occur in conjunction with a number of other components. The planning process and subsequent implementation of an integrated manufacturing strategy should therefore incorporate all of the following:

- change of organisational structure;
- new management techniques; and
- advanced forms of technology.

At the same time, the components listed should also be considered in light of the effects they may have on the workforce.

Integrated manufacturing is as much about effectively integrating the total human resources effort of a manufacturer as it is about integrating manufacturing functions.

Source: NIES, c. 1988-89, *Integrated manufacturing. Human resource implications*.

This chapter therefore addresses the implications each of the elements mentioned may have on the workforce. Particular attention will be paid to changes which may occur in job design (or redesign), job content and skill requirements of the workforce. As stated by the National Industry Extension Service (NIES),

Job redesign and human resource implications must be a major component of any examination of integrated manufacturing. [NIES, c. 1988-89 (a)]

Integrated manufacturing was defined in Chapter 1 in terms of a management approach which involves, in part, the application of advanced technology. The implementation of advanced technology into traditional mass producing organisations can alter the production process

quite dramatically. Most manufacturing organisations throughout the world are, however, still at the lower end of the learning curve with respect to advanced technology. That is, they are still in the process of discovering the numerous transformations technology can bring to the workplace. As a result, a number of questions have arisen concerning the impact advanced technology may have on the workforce. The following are several of the most frequently asked questions relating to the effects of advanced technology on the workforce:

- What demands, if any, do advanced forms of technology place on workers?
- Is it likely that new technology will make the human element within manufacturing organisations less important or even redundant?
- What changes will workers experience in relation to their job responsibilities and required skills, as a result of advanced technology?
- What effect, if any, will the introduction of new forms of technology have on women employed in manufacturing organisations?

While there is some debate as to what the exact consequences are likely to be, a review of the literature available at the time of writing goes some way to answering these questions. In general however, the literature surveyed did tend to suggest that the demands on the workforce are likely to increase as manufacturing organisations throughout the world increase their investment in new forms of technology, adopt new management techniques and alter their traditional organisational structures.

New competencies

The implementation of new management techniques and technologies can bring with them significant changes to employee responsibilities, abilities, and skill requirements. Furthermore, they can also lead to the demand for new competencies at all levels within a manufacturing organisation. Production workers, maintenance workers, supervisors and managers can all experience changes in their traditional areas of responsibility and traditional job activities in an integrated organisation. [Gupta, 1989]

Production workers

The implementation of an integrated manufacturing strategy is likely to bring a number of fundamental changes to the traditional job activities of production workers. The need for production workers to understand the entire production planning process is essential under such a system. As Nemetz pointed out in 'Human resource planning in flexible manufacturing organisations: Possibilities and concerns', production workers will need to broaden their skill base from that of merely *specific, routine skills*, to more *generalised, responsive skills*. [Nemetz, 1990]

Maintenance workers

The skill requirements of maintenance workers are also likely to change due to the increasingly sophisticated nature of technology within integrated organisations. It has been suggested that maintenance workers will require the following abilities:

- *more in-depth system knowledge;*
- *specialised equipment skills;*
- *an understanding of design, maintenance, operation of equipment, the jobs the equipment does, the materials on which the equipment operates, and the tools through which the work gets done.* [Nemetz, 1990]

Supervisors

The role of supervisors within integrated organisations, according to Gupta in 'Human aspects of flexible manufacturing systems', will no longer be that of just *watchdogs*. [Gupta, 1989] Rather than merely overseeing the activities of workers, supervisors will be encouraged to foster a more dynamic and involved working environment. That is, an environment in which workers have direct input and involvement in such decisions as *establishing procedures and improving operations, product quality and the entire work environment*. [Gupta, 1989]

Management

Management within integrated organisations will be confronted with the challenge of not only expanding their existing skill base but also changing their traditional way of thinking. A more lateral way of thinking and the development of a far broader range of abilities than those needed in traditional manufacturing organisations will become essential, as the role of the manager will be *mainly taken up with making the pieces fit together*. [Hayes and Jaikumar, 1988] This in turn will require the *integration of ideas from many different disciplines*. [Nemetz, 1990]

SUPERVISORS AND MANAGERS

Traditional role

- Tell people what to do
- Plan for them
- Control them
- Look at the individual year end performance
- Be business-result oriented

Emerging role

- To be a teacher
- To be a coach
- To be a facilitator
- To develop work teams
- To look at continuous improvements
- To not only be business-oriented, but customer-oriented, employee-oriented and business-result oriented

Source: Adapted from papers from the MTIA Enterprise Bargaining Seminar, 1991.

Systems operators

A group of workers who will bring a new set of competencies into an organisation are systems operators. This group of workers require the *ability to access, input and analyse computerised information*. They also need to have an *integrated understanding of a wide range of production and support functions*. [Nemetz, 1990]

While some of the changes that new management techniques and technologies bring to an organisation are positive, others may have adverse effects on the workforce.

Women

Women are one particular group which have experienced a number of disadvantages with the implementation of new technology. Crewe in her study of the West Yorkshire textile industry examined the plight of women within this industry. As stated by Crewe, women in the textile industry *tend to be under-represented in higher status, higher skilled jobs; that is, they are inclined to be concentrated in unskilled and semi-skilled jobs*. [Crewe, 1991]

This often means that when new technology is introduced into an organisation, the positions held by women are likely to be absorbed or eliminated all together.

It is perfectly reasonable to accept that the implementation of new technology has led to the deskilling and 'elimination' of women in certain areas of manufacturing. However, the issue which should be explored is why? What factors are contributing to this trend? Questions which could be raised in individual companies with regards to women employees include:

- Are women willing participants in training programs?
- Are there external factors which are preventing women from undertaking training? (e.g. lack of child care facilities, training after hours etc.)
- Are there certain aspects of the attitudes of management, women and society in general, which are preventing women from participating in training and entering non-traditional positions?

While these questions are general and the answers complex, they do provide a starting point in uncovering why women are at a disadvantage not only in certain areas of manufacturing, but in all areas of employment and training.

An issue which is currently receiving attention and has been the focus of recent literature is the 'skill formation process' in Australia and its impact on women. [SA DETAFE, 1992 (e)] Traditional male views of work, and community attitudes to women and their status in the workplace have played a major role in determining what constitutes a skill. There tends to be recognition of skills in male-dominated occupations, whereas activities which do not get defined as skills (e.g. childcare, housekeeping) tend to be those held by women.

'The social construction of skill' has, in turn, been identified as the *fundamental reason why the occupations in which women predominate (the 'feminised occupations') lack structured training arrangements.* [SA DETAFE, 1992 (e)] Training opportunities in Australia are concentrated in the primary and industrial services sectors, in which there is a significantly lower percentage of women than men. Women tend to be concentrated in the services sector, an area in which the number of structured training opportunities are restricted.

Worker apprehension

The present nature of the Australian training system does little to improve the situation. The entry-level training system has been identified as one of the main obstacles preventing women from participating in structured on-the-job training. This is due to the fact that apprenticeships make up the largest portion of entry-level training and apprenticeships are dominated by men. Therefore, the entry-level training system as it stands results in an imbalance of training opportunities in favour of men. [SA DETAFE, 1992 (e)] These imbalances are currently being addressed in the implementation of the Carmichael report.

It is also not uncommon for workers to feel somewhat apprehensive about new forms of management techniques and technologies. Techniques such as Just-In-Time (J-I-T), Total Quality Management (TQM) and Materials Requirements Planning (MRP or MRP-II) have been employed to improve and add flexibility to traditional production processes. However, while some workers learn to use and accept these new techniques and technologies, others remain anxious and refuse to welcome the benefits these new systems may bring. For example, prior to the implementation of MRP-II, all systems work in Australian firms was carried out manually. In recent years, a number of firms have implemented MRP-II to carry out this and other tasks more efficiently. Computerising the system however has brought with it a number of human resource problems. In a number of cases workers have not accepted MRP-II wholeheartedly. In such situations workers may only use the system to perform very basic functions and thus the true value and maximum potential of the system are not fully exploited.

The successful implementation of management techniques is reliant on an educated and committed workforce. As stated by David Needham of Manatech Pty Ltd *people are Total Quality Management, without them it won't work*. [NIES, 1989] Needham asserts that if we are to believe that people are an organisation's greatest asset, then they must be developed to their full potential.

Just-in-time

Modern management techniques have brought with them significant changes to worker responsibilities and duties. Oliver in his paper 'The dynamics of J-I-T' stated that advocates of J-I-T stressed that the implementation of such a technique would result in the increase of *responsibility and job variety for operators* under such a regime. There is, however, much debate as to what the actual consequences of J-I-T will be on the workforce. Suggestions include:

- a higher utilisation of labour;

- work may be more varied;
- a higher general level of competence on the shopfloor is required. [Oliver, 1991]

Numerous writers have also identified and documented both the positive and negative implications technological change may have on employees. Kearsley, in *Introducing new technology into the workplace: Retraining issues and strategies* identified three major effects the introduction of advanced forms of technology (in particular, computers, robots and telecommunications) may have on job skills and workers' knowledge. Kearsley described these as skill twist (requiring reskilling), upskilling and deskilling.

'Skill twist'

Kearsley defined 'skill twist' as the displacement of 'old' skills by a set of 'new' ones. The process used to design ships provides a dramatic example of skill twist. The old craft of 'lofting' has been superseded with the introduction of CAD technology. Because the design process has been computerised, the need for the manual craft of 'lofting' has been eliminated. CAD has revolutionised ship design. The designs produced by CAD are highly specific, far sharper and considerably more precise than 'lofting'.

The replacement of physical skills by mental skills is also encompassed by the term skill twist. As pointed out by Kearsley, the need for workers with traditional physical skills such as *assembling, welding or riveting* are also likely to diminish, as an increasing number of workers will be required to possess new 'mental' skills needed for such tasks as robot programming, maintenance and design.

McLoughlin in *The "Taylorisation" of drawing office work?*, also discusses the change that can accompany the introduction of CAD technology. McLoughlin stated that, with the implementation of CAD, old manual '*craft skills*' used in drawing are replaced by less complex dexterous manual keyboard skills. Prior to the development of CAD, the skills needed to manipulate a pencil involved a direct relationship between thought and action. This has now largely been replaced by the '*less dexterous skills*' needed to operate a keyboard.

Furthermore, according to McLoughlin CAD has made the relationship between the worker (user) and the actual act of drawing more *indirect and abstract*.

Despite these changes McLoughlin does however feel that the mental skills needed to operate a CAD system do *in some way compensate for the loss and kind of personal touch associated with manual methods*. It has also been suggested by a

number of writers that the *loss of manual craft skills in drawing tasks is positive evidence of deskilling*. [McLoughlin, 1989] The replacement of manual skills by higher mental skills is a questionable example of deskilling. Workers require higher-level skills to operate computer-aided technology and as Ebel stated, *there is little room in CIM for unskilled workers. CIM requires versatile craftsmen and technicians.....* [Ebel, 1989] In fact, it seems more likely that this process is an example of 'skill twist', whereby old traditional skills are replaced by new highly technical skills.

'Upskilling'

Kearsley identifies 'upskilling' as the second major impact that advanced technology can have on the workforce. This occurs when the implementation of new technology results in a need to 'upgrade' or increase the level of skills required to do a job. Kearsley provides the example of a factory supervisor being assigned the task of monitoring robots, which involves *new set up, safety and troubleshooting procedures*. [Kearsley, 1989]

'Deskilling'

Deskilling is the third major influence technology may have on the workforce according to Kearsley. Deskilling describes the process of reducing the level of skill complexity required for a human to do a job. For example, the increasing implementation of advanced forms of technology within manufacturing organisations may result in workers becoming mere *button pushers*. [Burgen and Molloy, 1990] A very real illustration of deskilling occurs when robots are installed to carry out the task of spray painting. As stated by Kearsley, this can reduce a human operator's role to that of *caretaker*, as a worker may only be needed to *refill paint tanks, replace nozzles and clean up the work site*. [Kearsley, 1989] The process of deskilling in this particular situation can actually benefit the worker, as there is an actual improvement in the tasks performed by the worker. Therefore, in occupational health and safety terms, the implementation of robots to carry out such tasks as spray painting can actually improve a worker's working conditions. The role of 'caretaker' is a far cleaner and healthier role than that of spray painter.

The most frequent criticism directed towards the implementation of advanced technology is that it can often result in jobs being downgraded from skilled to semi or even unskilled positions. This criticism is based on the assertion that in many cases automation reduces the complexity of each task employees are required to perform. Consequently, workers in such situations may find that they are assigned a greater number of more simple activities.

The justification for this criticism however, is open to question. Furthermore, the criticism raises a number of important issues. For example:

- Is technology alone responsible for the downgrading of jobs?
- Is it imperative that this process should occur or can it also be attributed to a deliberate strategy on behalf of management?
- Is there substantial evidence to support this assertion?

An argument which tends to negate the criticism that new technology simplifies the tasks of employees is based on the fact that experience has proven that the implementation of advanced technology is more than likely to make the role of the unskilled worker redundant. Advanced technology will require an increasingly highly flexible and multi-skilled workforce. As has been the case in Germany, *the need for semi-skilled and unskilled workers has experienced a constant decline in recent years.* [The Federal Minister for Education and Science, Bonn, 1992]

In Australia, the unskilled worker is becoming increasingly difficult to place in the system. By the very nature of progress and competition the unskilled worker will find it difficult if not impossible to compete with a multi-skilled and flexible worker.

A further counter argument to the above criticism is that the downgrading of a worker's job may not necessarily be a direct result of the implementation of new technology. In fact, it is more likely that this process occurs as a result of a conscious effort by management to reduce the skills of the workforce and subsequently the role they play in the manufacturing process.

The peopleless factory

American firms in particular have opted for such a strategy. That is, one which reduces the human element in the production process. Advanced technology has been seen as the key to increasing productivity and achieving a competitive position in the marketplace. Particular reliance has been placed on the strategy of computer integrated manufacturing (CIM). A substantial number of manufacturing organisations in the US have invested billions of dollars in advanced technology. As stated by Corbett, *the biggest names in American manufacturing have all been captivated by advanced manufacturing technology,* [Corbett, 1990] especially CIM, with the ultimate goal being that of the 'unmanned factory'. [Ebel, 1989] Workers within

such organisations are assigned peripheral tasks and ultimately become *incorporated gradually and progressively into the machines*. [Ebel, 1989]

The quest for the 'peopleless factory' has not been as successful as first hoped. In fact, it probably has more drawbacks than benefits. Firstly, the goal of achieving a fully integrated 'peopleless factory' which is totally dependent on advanced technology is an extremely expensive strategy. The expense and concurrent benefits of such a strategy have also been widely disputed.

Keeping in mind the questionable success a 'technocentric' strategy brings to a manufacturing organisation and the exorbitant costs associated with it, it is not surprising that the most successful manufacturing countries throughout the world have adopted strategies which involve the integration of new technologies with a highly skilled, educated, capable and efficient workforce.

Countries such as Japan, West Germany and Sweden have built their manufacturing strategy on the philosophy that *new computerised flexibility and integrated automation equipment needs a skilled and versatile workforce serving to enhance existing know-how and to permit greater flexibility, higher productivity, better quality product.....* [Ebel, 1989]

Japan

In Japan, technological implementation occurs on a gradual basis, in close conjunction with the workforce. Japanese manufacturing industries have rejected the idea of progressing in the technological field by great leaps. [Ebel, 1989] Furthermore, the dominant belief in Japanese manufacturing corporations is that advanced technology is useless without a substantial human element. Workers in Japan are encouraged to *express their skills, creativity and initiative by controlling the technology*. [SA DETAFE, 1992 (b)]

Sweden

Sweden, like Japan, has achieved world class manufacturing status by utilising the resources of their people. Such a strategy has helped bring about innovation, quality and productivity improvements in the goods manufactured by this country. This is in direct contrast to a number of American firms who, as stated, have turned predominantly to advanced technology to achieve these improvements.

Germany

West Germany has also placed a greater emphasis on the structural changes associated with the introduction of technological change. [Bolk, Förster and Haywood, 1989] Manufacturing organisations within the later three countries

have all attempted to build on the existing skill base of their workforce. In particular, this has involved the devolution of responsibility to workers on the shopfloor, the use of the skills and intelligence at all levels and the sustained encouragement for workers at all levels to achieve high and growing qualifications. [Bolk, Förster and Haywood, 1989]

Australia

As stated by the NIES, many Australian firms are now considering the human aspects of their business in conjunction with other aspects of their organisation (e.g. technology). Two companies which have put a new emphasis on their workforce are Henderson's Automotive and Davey Products. Both companies realised that it is not sufficient only to invest in technology/equipment without also developing the skills of the workforce. For Hendersons this realisation was bought about by the threat of closure. As a result of changes to company strategies, *Hendersons has found the key to international success through its people.* [NIES, 1992] As well as making a substantial investment in new equipment, Davey Products has also put into action the following Japanese philosophy:

Improved performance comes through the creativity of everyone in the organisation

Source: NIES, 1992, *Improvement through people: Case studies of the former contribution of labour (COL) program.*

Multi-skilling

Therefore, it is not surprising that developing the skills of the workforce and striving to achieve a multi-skilled workforce is becoming the most important job requirement of the 1990s. Multi-skilling can be defined as the acquisition of a number of discrete skills which equip a worker to perform a variety of tasks across occupational boundaries. (This definition is an adaptation of the one provided by COSTAC) Increasingly firms are realising that *the most successful forms of work organisations are those which encourage people to be multi-skilled.* [Mayer Committee, 1992 (b)] Crewe in her paper 'New technologies, employment shift and gender divisions in the textile industry', identified multi-skilling as the most fundamental change within the labour force in the last decade. While past work practices often required workers to carry out one or maybe even two tasks, workers are now required to carry out and be competent in numerous tasks.

All the textile firms studied by Crewe indicated that further multi-skilling was desirable. In fact, the consensus amongst all the firms was that the *labour force will be moving increasingly in this direction in the future*. [Crewe, 1991]

Jacobs, in 'Training for new manufacturing technologies' also referred to the broader and more involved role workers may have to assume within integrated working environments. That is, workers will need to develop a broader range of skills which will allow them to operate and understand the workings of more than just one piece of equipment. An understanding of an integrated system will be essential. [Jacobs, 1988]

The necessity for workers with new and multiple skills has also been identified by Badham and Wilson. They concluded that it is not until workers are trained to *operate and maintain the system* that new *off-the-shelf* technology becomes *working technology*. [SA DETAFE, 1992 (b)]

It seems however, from the literature surveyed, that multi-skilling has also brought with it a number of concerns. In particular, one of the major concerns is the effect it may have on the workforce. A number of writers have suggested that multi-skilling has the potential to lead to the creation of new divisions within the workforce. For example, it has been asserted that tensions could arise between the 'flexible' multi-skilled worker and the semi-skilled or unskilled worker as *the semi- or unskilled worker...may experience an erosion of rights and responsibilities*, as their role in the workplace becomes more peripheral. [Crewe, 1991] Current trends in the workplace indicate that unskilled workers are already finding it difficult to find work in the system. If this current trend continues, the role of the unskilled worker will be probably eliminated altogether from the labour force. If this occurs, then the likelihood of such tensions arising diminishes. Equity concerns (as dealt with earlier in this chapter) and training concerns (which will be discussed in the following chapter) have also been raised.

Workforce numbers

A further consequence of technological change may be the reduction in the number of people employed within a particular organisation. As stated by Crewe, technological changes are altering not only what is required of people within the workforce but also the numbers of people employed. This has already occurred to a significant degree within a number of manufacturing organisations throughout the world. A case in point is the Fiat Mirafiori factory (Italy). Employee numbers within this organisation went from 60000 to 25000; a dramatic reduction of nearly 42% of the

Higher-level
skills

workforce. The Fiat Mirafiori factory is not an isolated example of management reducing staff numbers. The strategy has been widely implemented amongst car manufacturers throughout the world. [Bolwijn and Kumpe, 1991]

The Containers Packaging (Roclea, Qld) Plant in Australia provides a stark contrast to the previous example. One of the company's main activities is the production of two and three piece seamless cans. Employing approximately 180 people in the 1970s, the company has almost doubled its workforce. Current workforce numbers are in the vicinity of 380 employees. [SA DETAFE, 1992 (c)]

As well as being multi-skilled, workers within integrated organisations will also need to possess higher-level skills. This will become increasingly important as the *increasing technology content of both products and processes calls for well-educated personnel*. [Bolwijn and Kumpe, 1991]

The increasing implementation of computerised technology (eg. CAD/CAM, CIM) also calls for well educated people. As Jacobs, in *Training for new manufacturing technologies* stated:

Computer driven manufacturing processes will require higher level skills of remaining workers, both technical competence and the critical thinking ability. [Jacobs, 1988]

Workers will find themselves in the inevitable position of having to upgrade their skills as an increasing number of manufacturing organisations throughout the world implement advanced technology, be it robotic or computerised. As Leahy, in 'Human resources management in Ireland - the role of FAS', stated:

Successful economies of the 90s will be those who are capable of utilising to the full the potential of the new technologies and this, in turn, requires a workforce which has strong intellectual and conceptual skills and which is highly flexible and adaptable. [Leahy, 1990]

The benefits which can be derived from advanced technologies will be limited if there is a shortage of skilled (i.e. multi-skilled or higher-level skill) workers.

People as a
valuable asset

The belief that people are one of the most valuable assets of an organisation is slowly gaining momentum. Experience has shown that technology alone does not provide the 'magic' solution to all manufacturing problems. Nor does the implementation of new technology alone necessarily strengthen an organisation's competitive position.

The following is an excerpt from Crewe's paper 'New technologies, employment shift and gender divisions in the textile industry'. Despite the fact that Crewe is describing the situation which has arisen in the British textile industry, the excerpt can be applied on a far broader basis. The excerpt summarises changes which should take place within all manufacturing industries throughout the world.

Production process transformations alone will not ensure the future success of the textile industry, and it is time that a comparable 'revolution' in the labour process took place, whereby management recognises that real investment in human resources is urgently needed. [Crewe, 1991]

Companies who make a genuine investment in their workforce (e.g. in the form of training etc) will have a definite advantage over companies who do not. An essential area which employers should concentrate on is making sure that employees possess basic skills in literacy, numeracy and communication. If employees do not possess such skills, then it is in an organisation's best interest to assist in the development of such skills.

This step should precede any attempt by management to develop the 'higher-level skills' of the workforce. An attempt to develop 'higher-level skills' in workers who do not possess basic skills such as literacy and numeracy will be futile.

The objective of achieving a 'flexible' integrated workplace will be dependent on a multi-skilled, highly skilled workforce. Changes associated with integrated manufacturing (eg. organisational changes, changes in management techniques and technology) will not take place without difficulty if a workforce cannot deal effectively and competently with such changes.

The development of higher-level workforce skills has therefore become inevitable and imperative. Management must make a concerted effort to encourage workers to raise their skills. Jacobs writing about the American automotive industry, points out that there is a long-term trend to lift the skills of production workers within this industry. As a result,

The percentage of skilled workers versus unskilled workers in overall industry wide employment has increased. [Jacobs, 1988]

The skills of US production workers have, however, been notoriously low. Traditionally, US manufacturing firms

trained their production workers to carry out simple tasks. Workers then carry out their allocated task for the remainder of their time with their particular company. Therefore, the trend to lift skills in American manufacturing organisations has begun at a fairly low skills base.

Job content

From the literature available, it can be summarised that broad changes to job content will take place and a greater emphasis will be placed on qualities such as teamwork, initiative, creativity, entrepreneurship, problem-solving, openness to change and responsibility. [Mageean, 1989] According to Mageean such demands will be placed on workers at all levels within an organisation as the demand will increase for broadly skilled staff at all levels in the design, production and management processes. [Mageean, 1989]

Key qualifications

A number of writers, Grosse and Förster in particular, have identified a number of *key qualifications* which workers will need, in order for them to work successfully in an integrated manufacturing organisation. Key qualifications described by Grosse include:

- *the systematic, analytical approach to independent task planning;*
- *self-initiative;*
- *willingness to accept responsibility;*
- *resoluteness, adaptability;*
- *recognition of personal limits;*
- *ability to acquire and share knowledge;*
- *co-operation, teamwork, fairness and social sensitivity.* [Grosse, 1991]

Grosse developed these key qualifications on the basis that:

Automation = Mechanics + Intelligence

Förster also described a number of *key qualifications*. Förster stated that even though *higher requirements on skilled training* are required from workers in manufacturing organisations, *broad based non-specific skills or competencies* are also required. These include:

- *skill competence, which includes the specialised knowledge of products, materials and production processes;*

- data processing competence, which includes the ability to use and maintain the tool "data processing system";
- methodological competence, which includes procedures for analysing and solving production problems;
- social competence, which involves the ability to co-operate, solve conflicts and lead fellow employees;
- learning competence, which indicates the readiness and adaptability required for continuous learning. [Bolk, Förster and Haywood, 1989]

There is a growing commitment within Australia, both on the part of Government and a number of progressive firms, to foster the development of a better educated, multi-skilled, creative and adaptable workforce. Australia needs a highly skilled workforce which is able to operate more flexibly and with greater innovation at all levels. [Australian Education Council Review Committee, 1991 (b)] To nurture this commitment the Finn Report recommended that Australia as a nation should provide all young people with a programme of education and training which would prepare them for life as individuals, citizens and workers.

Finn

To facilitate this process the Finn Report identified six areas of competence. These included:

- Language and communication;
- Mathematics;
- Scientific and technological understanding;
- Cultural understanding;
- Problem solving;
- Personal and interpersonal.

Mayer

Following the recommendations made by the Finn Committee, the Mayer Committee proposed that the following key competency strands be developed:

- collecting, analysing and organising ideas and information;
- expressing ideas and information;
- planning and organising activities;
- working with others in teams;
- using mathematical ideas and techniques;
- solving problems;
- using technology.

The objective behind the development of such competencies was so that *workers can apply their knowledge and skills in an integrated way in work situations*. [Mayer Committee, 1992 (b)]

Problem solving

The ability to problem solve is a competency which has attracted substantial attention throughout the literature surveyed. One school of thought tends to suggest that this skill is essential for any worker who has to use and understand technology, as technology requires workers with *a problem-solving methodological type of ability* [Kearsley, 1990].

The ability to problem solve has been closely linked to productivity by the Mayer Committee. This association is supported by the following statement which appears in the Report:

The results of problem solving have the potential to generate creative or innovative solutions that offer new approaches. [Mayer Committee, 1992 (a)]

Mageean in 'The implications for tertiary vocational education of the government's emphasis upon skills formation' identifies the ability to problem solve as one of the essential skills needed from the workforce.

A flexible workforce

There is, however, some debate surrounding this particular competency. The question has arisen as to whether problem solving is a transferable generic skill. That is, does the development of a problem solving competency enable workers to adequately cope with a wide range of problems in a number of different settings?

Workers with traditional skills are becoming obsolete. The new flexibility which is an integral part of an integrated manufacturing strategy needs a complementary flexible workforce. A workforce which reflects the demands of the marketplace.

The traditional marketplace which was once characterised by *stability, specialisation and the division of responsibility* is now being replaced by a marketplace which is characterised by *agility, responsiveness and flexibility*. [Bolk, Förster and Haywood, 1989] The workforce in turn must be flexible and responsive and in control of the manufacturing process. As stated by Förster, *workers must still control and guide the process*. [Bolk, Förster and Haywood, 1989]

However, the extent to which workers will be able to integrate with advanced forms of technology and management techniques will depend on the extent to which management are willing to support and encourage their workers.

Ebel firmly believes that the strategy which has consistently paid off best is one which:

- *builds up the skills, responsibility and motivation of the workforce;*
- *invests in people who are to operate the system; and*
- *relies on the human factor to make it flexible. [Ebel, 1989]*

On this basis, the ultimate success for manufacturing organisations is to be found in the integration of technology, management techniques and organisational structure with the workforce.

4: Investing in training

Simply investing money in new technology or systems guarantees nothing. Without education and training, the potential benefits are never achieved. You can not buy productivity, it has to be earned by training and investment in people....the investment with the best return is education and training [Crewe, 1991]

Integrated manufacturing and training

Integrated manufacturing will have the effect of considerably increasing the demand for training in the future. Traditional and existing skills of the workforce must be both raised and diversified to keep up with organisational changes, new management techniques and technological advances, as discussed in chapter 3. Furthermore, courses will need to prepare workers for likely changes resulting from integration and develop an individual's ability to:

- adapt to changes in technology;
- readily transfer skills to new areas of specialisation;
- combine skills in two (or more) disciplines;
- readily accept and seek retraining at appropriate points through working life;
- pass on knowledge to others;
- appreciate business strategies.

The necessary changes however, do not occur overnight, nor do they occur without sufficient and well-planned education and training programs.

Co-operative training

The planning process should involve substantial input from a number of central parties. Key players should include industry, government, schools and education/training providers. In this way, the qualifications received by students at the end of their schooling should be *portable and reflect the common standards agreed upon both by schools, all states, industry and higher education*. [Australian Manufacturing Council, 1988]

While the development of education/training programs has traditionally been the responsibility of schools, education/training providers and governments, it is increasingly important that industry take a more active role in this process.

In particular, there is an ever increasing need for programs to be co-ordinated by both business and vocational training providers, such as TAFE. As stated by the Australian Manufacturing Council (AMC), *changes need to take place both within industry and within the education and training system*. It is vital that a two-way process be established.

The dual system

In the Federal Republic of Germany vocational training is the responsibility of and relies on the co-operation of employers, employees, state and educational authorities.

The German vocational education system is called the 'dual system'. The dual system requires students (or trainees) to undertake training within a vocational school and on company premises. The role of company training is predominantly to *fill gaps in general education*. [Federal Minister for Education and Science, 1992]

The vocational training system is highly regulated in Germany (two acts which cover vocational training are the 1969 Vocational Training Act and the 1981 Act for the Promotion of Vocational Education).

While such a rigid and highly regulated framework may not be appropriate for Australia, an examination of the system reveals that there are a number of features and philosophies which could be embraced by Australian employers, governments, training providers and workers.

German employers genuinely believe that providing training on the shop-floor is *the best way in which to provide for their own need for a skilled workforce*. [Federal Minister for Education and Science, 1992] Furthermore, employers believe that increased productivity and competitiveness are a direct outcome of having a skilled workforce.

Key features of the Germany vocational training system which should be noted include:

- the content of their training programs are frequently adapted to accommodate changes in technology, the economy and production conditions;
- their training programs attempt to incorporate foreseeable developments in the above areas;
- the system attempts to ensure that vocational training is standardised particularly between companies with similar needs;

- there is a belief that an investment in vocational training is an investment in the future;
- training provides young people with the ability to react flexibly to new occupational developments. [Federal Minister for Education and Science, 1992]

However, the point of greatest relevance which can be learnt from the German model is that Australian industries need to provide a greater input into the development of education and training programs, so that workforce skills are more in line with their needs.

Swedish vocational education and training

The vocational education and training system in Sweden is one of the most responsive to the needs of industry in the world. The system is constantly adapted to meet the needs of *industry and society in a rapidly changing environment*. [COSTAC, 1990 (a)] The demand from industry for a higher skilled and flexible workforce has meant that employers and unions are both actively involved in the education and training system. As stated in the COSTAC report, while the Swedish system is not a perfect one it still has many strengths. Amongst the most notable strengths of the system are:

- the extensive availability of adult and continuing education and training;
- the importance of equity in all sectors of education and training;
- vocational education in Sweden has prestige and status;
- training is very closely associated with work. [COSTAC, 1990 (a)]

Practical & theoretical

The link between practical training obtained in industry and theoretical training learnt at colleges/institutes is becoming increasingly significant as few training institutes have the capacity to purchase or keep up with the rapid changes in advanced technology. As stated by Grosse, *educational institutes suffer the handicap of being unable to keep up with rapid technological changes*. [Grosse, 1991] On the other hand, few companies have the capacity to offer training internally. [Nemetz, 1990]

It is believed that the gap between what can be provided at educational and training facilities and what is needed in industry is widening. [Grosse, 1991] This is a concern which is shared by a number of writers. A further point raised by

Grosse with respect to this factor is that the speed of technological changes and the rapid changes occurring in work practices highlight the need for a more formal arrangement between the two parties.

While there is an increasing realisation that education and training programs should be jointly co-ordinated, there are questions as to what role industry should take. Firstly, regarding the development of training programs and secondly, what role they should play in providing employees with suitable training.

Role of industry

Much of the literature tends to suggest that companies should make a significant contribution to the training process. It has been stated that:

- Industry should provide schools with some input into what skill requirements they would like students to develop.
- Companies should accept some responsibility for training their employees.

While many organisations may not have the financial resources necessary to provide in-house training, their informed input into the formal training system is nevertheless necessary.

Education and training programs are far more useful and effective if they take into consideration the needs (both short and long term) of employers.

Awareness of the benefits of developing links between training providers and industry is slowly gaining momentum in Australia. The Ford Training Centre at Geelong, Victoria is one example of a successful joint venture. [Australian Manufacturing Council, 1988] Overseas examples of courses which are jointly developed and delivered using the educational expertise of a college or institution and the technical expertise and equipment of a company can be found at the German-Singapore Institute in Singapore and the Coventry Polytechnic in England.

Informed input from manufacturing industries is particularly important as their needs are changing at an ever increasing pace.

Community needs

While education and training programs should take into account the needs of industry, they should also cater for the needs of a wide spectrum of the community. For example,

many women return to the workforce after having been out of the system for some years only to find that their skills have become obsolete. Training programs which meet the needs of those who want to make the transition back into the workplace are therefore essential. This is just one example of a group within the community with specific needs. Other groups include:

- students;
- workers (who need to have their skills upgraded or for workers who have obsolete skills);
- the unemployed;
- migrants; and
- the disadvantaged.

The provision of a range of educational and training programs which cater for people at different stages of their lives and with different needs, can then provide the foundation for life-long learning.

Life-long learning

People need to gain and develop their skills on a continuous basis. As a result, it is necessary for changes in education and training to be made at all stages of the learning process.

For employees (current and future) to meet the educational and skill requirements needed to successfully participate in the integrated workplace of the 1990s, changes will need to occur at all of the following stages in a person's life:

- Primary education;
- Secondary education;
- Tertiary education/training;
- On-the-job (*involves courses provided by equipment manufacturers as well as company-developed courses* [Kearsley, 1989])

Individuals acquire the basic foundations for further skill acquisition and development during their school years. Therefore, educating the workforce of tomorrow, needs changes in schools today. Children need to be taught skills which can be continually developed and enhanced throughout their lives.

As stated by the Australian Manufacturing Council, it is vital that schools:

Develop young people so that they possess the basic cognitive skills on which specific work skills can later be built [Australian Manufacturing Council, 1988]

It is also becoming increasingly important to develop skills in young people which allow them to flexibly adapt to *new occupational demands*. This is a major aim of the dual system in Germany. However, because changes in vocational demand are difficult to predict, *the content and requirements of the training must be geared to subsequent vocational mobility and a willingness to undergo further training*. [Federal Minister for Education and Science, 1992]

Curricula

If young Australians are to develop new skills then the current school curricula needs to be expanded and/or modified. Various recommendations have been made throughout the literature surveyed regarding the possible changes which could be made to curricula content. The Australian Manufacturing Council has made the following suggestions with respect to schools. Several of the following points also reflect key elements identified by Mayer and Carmichael. Suggestions include:

- improve and review, on a continuous basis, the basic skills of literacy, numeracy, science, communication and computing;
- ensure that students are taught about the role of the manufacturing industry in Australia's development and be given a positive understanding of the world of work;
- place more of an emphasis on *vocational* studies, such as business, technical, service and management studies.

While schools should provide students with the skills necessary for either continuing their education or entering the workplace, in many cases this fails to happen. A study conducted in the US revealed that a third of 'front-line' workers are high school drop-outs, often illiterate and innumerate. Despite these deficiencies, a surprising number of employers said they were satisfied with the skills of high school graduates. The problem of low level skills is further compounded by the fact that there are *few schemes to help students make the transition from school to work*. [The Economist, 1992 (a)]

It is findings such as these which are particularly worrying, as they are not confined to any one country. If such complacency exists on behalf of employers then promoting the case for training is made all the more difficult.

Traditional attitudes

The findings also bring to light the problem of changing traditional attitudes. The benefits to be gained from high-tech equipment and integrated manufacturing will falter unless there is first a dramatic change in organisational philosophies towards the importance of skill development.

The difficulty in changing employer attitudes to training could be partially attributed to the fact that prior to the 1970s - 1980s most workers could adapt quite readily to new machinery. In general, the implementation of new machinery into a manufacturing organisation did not require workers to develop an extensive range of new skills.

Since then however, technological advances and new work structures have had a far greater impact on workforce skills. As a result, training in the future will take a more routine role in manufacturing organisations. It has been stated by Nemetz that experienced trainers predict that as much as 20% of workers' time will be spent in education and training. [Nemetz, 1990] While this figure may be rather generous, it nevertheless indicates that workers will be required to undergo considerably more training than in the past.

Advanced technology

The complexity of technology and the fact that it is often computer-based has also placed new demands on workers. Training has therefore taken on a new significance in this context. Jacobs in 'Training for new manufacturing technologies', writing about computer-based technology, stated that a study of 16 major plants who had introduced computer-based manufacturing technology found:

- *A significant increase in skills necessary to conduct most hourly engineering and management work.*
- *Each plant had significantly increased its training programs for all occupational categories.*

As stated previously, training programs will need to not only focus on the technological needs of workers, but will also need to cater for the broader range of skills required of workers in an integrated manufacturing environment. To accommodate these changes, the most frequent recommendation made throughout the literature is that skills need to be upgraded and generalised. [Nemetz, 1990]

With respect to advanced manufacturing technology and TAFE courses it has been suggested that there is a need for TAFE to:

1. include more generic and general vocational education;
2. come to terms with cross-discipline training;
3. work in partnership with industry;
4. help firms develop 'internal labour markets';
5. deliver training to adult clientele;
6. include a range of skills previously considered the exclusive domain of 'management training'. [SA DETAFE, 1992 (b)]

A number of the points listed have already been discussed in this chapter. However, points one, three and five keep reappearing throughout the literature, with the first of these points receiving substantial attention in the Finn, Mayer and Carmichael reports. With regards to adult workers, Grosse states that it is necessary to distinguish between skills training for adolescents and training for adults who are already in the workforce. This is attributed predominantly to the fact that *adults are particularly vulnerable to changes in technology and have a great need to acquire new knowledge and skills*. [Grosse, 1991] The Carmichael report also identifies this need.

It is also important for the training process to have a number of different functions. That is, not only should it provide workers with the necessary competencies to perform efficiently in the organisation, training should also provide workers with the opportunity to *learn why they are being asked to change and how they are to change*. [Mageean, 1989]

Furthermore, training should also cater for the needs of a wide range of employees. One particular group with specific training needs are managers. Managers within integrated manufacturing organisations will experience a number of major changes to their traditional areas of responsibility. The role of managers within such organisations will become a lot broader and will need to take into account all aspects of the manufacturing process.

Managers therefore, will need training in such areas as advanced technology, problem-solving, managing teams and organising their operations with the entire organisation in mind. Courses which have been identified by Majchrzak which could prove the most useful for managers include:

- long-term planning;
- forecasting;

- action planning;
- test assumptions and implementation.

In order for managers to acquire such skills there is a need to combine in-house training with training provided externally. External providers such as TAFE must, however, develop a:

profound understanding of what lean, flexible, innovative, firms needs to do to achieve 'international best practice'.
[Anderson, 1991]

In many cases however, both managers and other staff members may resent the need for training. Employees who have not undergone any formal training or completed their schooling many years ago may feel intimidated by new training demands. Therefore, it is essential to prepare employees for the changes they are being expected to make.

It is not only employees within industry who will need to make changes as a result of these new demands. Teachers too will have to become more aware of industry needs and develop a more hands-on approach to training. Rapid changes in technology and the changing nature of industry has meant that it is essential for teachers and lecturers to become more in touch with industry needs and deal more closely with organisations. As Mageean suggests:

To keep up with modern technology, work organisation and new developments in training, co-operation with learning arrangements with industry are needed. [Mageean, 1989]

The changes brought about by integrated manufacturing and associated technological and organisational changes have and will continue to have far reaching implications for:

- all segments of the education and training system;
- a wide range of individuals; and
- a number of key players who should be contributing to the development and provision of programs (i.e. training providers, governments, industry, etc.)

The most notable changes will include:

- School curricula and training programs of the future will need to provide individuals with the ability to adapt as smoothly as possible to the frequent changes occurring in industry.

- Teachers, lecturers and instructors will have to frequently update their skills.
- The manufacturing industry will have to develop closer links and provide input into the formal education system.
- Employees will need to recognise the importance of life-long learning.

If the benefits of such strategies as flexible manufacturing are to be realised then the Australian education and training system must reflect the changes taking place in the manufacturing industry. As stated by Förster:

The factory of the future cannot be operated by personnel with yesterday's training. [Bolk, Förster and Haywood, 1989]

5: Conclusion

People as an asset

A key theme of this report is the fact that people are one of the most important assets of an organisation. However, people are an asset which is often neglected. A committed and skilled workforce is the key to an integrated manufacturing strategy. Therefore, for employers to reap the full benefits of integrated manufacturing, workers can no longer be the forgotten asset.

Integrated manufacturing relies on workers who can:

- deal effectively with and adapt readily to new technology and management techniques;
- cope with organisational changes;
- deal with the ever changing demands of a complex market-place, one which demands innovation and flexibility.

These changes require workers who possess a range of skills which are considerably different from those needed in traditional manufacturing organisations.

Technological change

Until the 1980s technological change did not have as dramatic an impact on workforce skills as technological advances are having today. Existing skills could be more or less adapted to new machinery. Today however, due to the complexity of technology and the impact technology has on the entire workplace, the demands placed on employees are increasing at a rapid pace. New developments in technology such as CAD, CAM, robotics and so on, require significant changes in the workforce skill base.

As a result, workers in manufacturing organisations today need to be multi-skilled and need to possess higher-level skills. In addition, workers need to expand their skill base not only to cope with technological changes but also to contend with new management techniques and organisational structures.

This requires training programs which address the complete range of employees' needs. Training

Skill development

programs should cater for workers who not only need to acquire higher-level skills but who need to develop their basic range of competencies (e.g. literacy and numeracy).

Numerous organisations having implemented an integrated manufacturing strategy only to discover that technology alone is not enough to increase productivity. The strategy also requires a genuine commitment to enhancing workforce skills.

This commitment to skill development not only applies to advanced complex technology, it can also apply to something as familiar as a wordprocessor. An enormous amount of hardware is currently underutilised because workers are not given sufficient training. Consequently, while the physical possibilities for improvement may already exist in an organisation, because the human dimension has not been developed the machinery is underutilised.

A possible solution to such a problem is to recognise the skills of existing staff. Employees who are proficient at their tasks could take on an in-house training role. Staff who demonstrate a personal capability could be developed and licensed to take on a training role. For example, a particularly competent wordprocessor could supervise and provide instruction to other operators or other staff members. This could in turn possibly encourage workers to seek training. A fellow staff member who undertakes the role of trainer may not be as threatening or intimidating as an external trainer.

Such a system could provide staff with a number of alternative career opportunities. For example, an employee with a specialised skill could be given the opportunity to supervise and/or train other staff members. A person with a particular area of competence could also be an invaluable information resource in the system. In this way training is institutionalised and information sharing is formally recognised.

The realisation that a skilled workforce is the key to Australia's competitiveness is currently having and will increasingly have a dramatic impact on:

- schools;
- TAFE;

Training programs

- other training providers; and
- industry.

All the institutions listed will be affected in some way. Schools will need to examine and modify their current curricula. TAFE and other training providers will also need to revise their training programs to accommodate the new demands. Furthermore,

- Training programs will need to be revised on a continual basis so that they keep up-to-date with frequent technological changes.
- School teachers and training instructors will have to keep up-to-date with changes occurring in industry.
- Industry and training providers will need to work closely together.
- There will be enormous cost implications for all parties involved.

Training for integrated manufacturing has also highlighted the need to distinguish between training for young people and adults. The training needs of these two groups are in many cases quite different and require a different approach.

Workers who have been out of the education system for a number of years may find formal training threatening and stressful. They may also find themselves in a situation in which they have to be reskilled or undergo training which provides them with a completely different range of skills.

The changes occurring in the manufacturing arena highlight the need for changes in training, particularly with respect to existing employees. Updating and modernising the skills of workers currently in industry needs to be given priority.

Organisations such as IBM and Volvo, who have made a genuine commitment to training their staff and invested a substantial amount of capital in training their workforce have reaped the benefits. As stated by Mageean:

It is no accident that companies who invest in on-the-job training and retraining programs are industry leaders. [Mageean, 1989]

Training Guarantee

However, much depends on the quality of training provided.

The Australian government has made an attempt to increase employer commitment to training through the Training Guarantee. The Training Guarantee requires that all employers or firms with a payroll of \$200,000 or more to spend the equivalent of 1% of their payroll in training.

There have already been some real improvements in the private sector as a result of the training guarantee. A survey conducted by Peat Marwick in 1990, of the manufacturing industry indicated that the training guarantee was having a positive effect on in-house training. The survey revealed that the percentage of both large and small companies reporting in-house training schemes had increased substantially between 1989 and 1990.

Percentage of in-house training schemes

	Small firms	Large firms
1989	5%	25%
1990	65%	80%

Source: KPMG Peat Marwick, 1990, Manufacturing survey.

However, the Training Guarantee has significant weaknesses. It provides no control over who receives the training or the quality of training. In many cases while managers and professional staff receive training, the training needs of other staff members are often neglected. Without sufficient control over these two factors, the full potential of the training guarantee is somewhat diminished.

A commitment to training

Numerous government policy documents address the issue of upgrading the skills of existing workers, but specific program objectives or measures to address this issue have not yet been implemented.

One of the major weaknesses associated with the training guarantee which was not discussed above, is the scale of activity. While it appears that the scheme has been reasonably successful, one can question whether a 1% payroll levy is sufficient for the scheme to be really effective and to result in any major change. Since the scheme has already resulted in some changes, perhaps it could be extended so that the current payroll levy is increased to 3%.

The benefits to be gained from training are dependent on an enormous range of factors. Governments must encourage and provide a framework and initiatives for change, workers must take up the challenge and make a commitment to training, and employers also need to make a genuine commitment to training their employees. But most importantly management must adopt a philosophy which motivates workers to use their skills. As stated in the Economist, until employers are willing to *devolve authority to workers, you can educate and train as much as you like, employees will never have the chance to show off new skills.* [Economist, 1992 (b)]

There are no panaceas for the Australian manufacturing industry, but the strategy of integrated manufacturing may be the most effective way of improving the productivity and international competitiveness. However, do our current initiatives and convictions provide the support necessary for the strategy to work? The following are questions which we need to ask ourselves with respect to the future of our manufacturing industry, the economy as a whole and the role of education and training within this framework.

- a) How much more commitment to structural training will be required of employers and others if Australia is to become internationally competitive?
- b) Do Australian employers invest and provide training and initiatives that reflect the genuine belief that a skilled workforce is a necessary part of economic success?

- c) Is there a need for a dramatic change in management/worker philosophy regarding the importance of training and implementing new strategies - not only for overall economic improvement but also for greater company productivity?
- d) Do workers want to actively participate in training and do they want to take on more responsibility?
- e) Is the goal of making Australia more competitive shared amongst the government, employers and workers?

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